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The Environmental Kuznets Curve and Corruption in the Mena Region

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Abstract

One of the current concerns of our planet is the degradation of the ecosystem which seems to be ascribable with the climate changes and which is likely to cause strong negative externalities which threaten the wellness of the populations as well of the countries developed as in the countries in the process of development.
This research aims to study the effect of corruption on pollution and per capita income of 21 countries from the MENA region over the period 1996-2013, through the use of a dynamic panel data model. The main statements issued from this empirical test stipulate a positive direct impact of corruption on per capita emissions and a negative indirect effect of corruption on per capita income.
Our results support also the Environmental Kuznets Curve hypothesis for carbon dioxide.
The environmental quality deteriorates at early stages of economic growth and subsequently improves at a later stage.

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Keywords: Corruption, Pollution, Income and Environmental Kuznets curves

1. Introduction

The relationship between humans and the natural environment has always been complex. Therefore, man can exploit natural resources without limit, in the recitals as a raw material to be introduced into the manufacturing process to achieve the finished products.

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This behavior has led to various negative environmental impacts that have affected humans, which generated an awareness of the need to preserve the ecological environment.

Given the scale of the issues related to the deterioration of the natural environment has generated development of political, social and economic actions aimed break with practices that affect our environment and degrade the quality of life of nations, several researchers are interested in this phenomenon in the regulatory framework for the environment. This can be explained by the emergence of the phenomenon of corruption which has become a major development challenge.

Currently, sustainable development has represented one of the most important policy goals explored in the environmental Kuznets curve (EKC) literature. The destruction of the environment following a pace that is still very fast. Not only the stock of natural resources will deplete because of deforestation, fires and overexploitation, but also the natural environment is being destroyed by urban and industrial pollution increasingly important.

The paper is organized as follows. In Section 2, we present the theoretical background focusing on the relationship between corruption and pollution on the one hand and the relationship between pollution and per capita income on the other hand. Section 3 motivates our econometric specification and discusses the variables of interest as well as other controls. This section also elaborates the empirical model and discusses the key issues of estimation. We present in this section the empirical results and the findings of the simulation analysis. To achieve this objective, we used the panel data method for a period from 1996-2013 which involves 21 countries. Finally, Section 4 concludes.

2. Literature Review And Hypotheses

2.1. Concept and extent of corruption

Corruption is a global phenomenon that particularly affects developing countries. In the absence of effective action, it can thwart efforts to fight against poverty and ineffective governance.

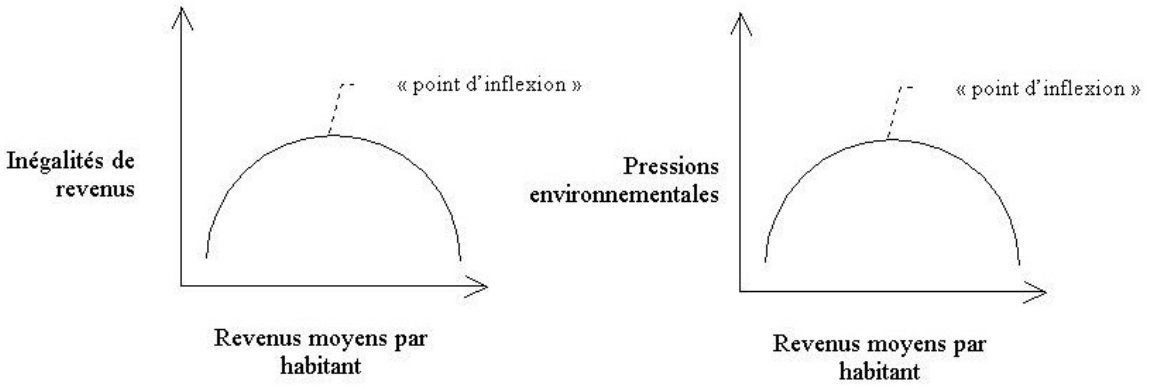
Its multiple misdeeds (waste of limited financial resources, reduced growth, increased transaction costs, decreased quality, increased uncertainty, creating an environment of insecurity, etc.) can jeopardize social and political stability of the country.

Corruption is by definition a hidden behavior. Its measurement is difficult. The non-governmental organization Transparency International has designed and built a Corruption Perceptions Index (ICOR) developed on an annual basis. The construction methodology of the index was proposed by Johann Graf Lambsdorff (1999) from the University of Göttingen. The CPI refers to the perception of the degree of corruption as seen by business people, country analysts, both residents and non-residents. The CPI is standardized to vary on an orderly scale of 0 (highly corrupt) to 10 (least corrupt).

According Paldam (2002), this index has a lot of inertia because the impression of a respondent is based on his own experience; they are not necessarily limited to a calendar year, but are probably formed over a long period.

2.2. Theoretical Foundations for environmental Kuznets curve

In 1950, the American economist Simon Kuznets hypothesized that there is a relationship "U" between the level of economic development social inequalities. Following several empirical studies, it appears possible that the developments of certain pollutants compared to the level of wealth of a country follow a similar path from where the "environmental Kuznets curve" (EKC).



Environmental Kuznets Curve (Boutard et al ., 2…)[†]

This attractive hypothesis has inspired a number of economists who have tried to observe whether the same phenomenon was valid for environmental issues, in other words, when a country develops, it creates the conditions for a further deterioration of its environment.

The environmental quality attracted the interest of many economists that's why they investigated the relationship between pollution and corruption and as mentioned above this relationship is characterized by an inverted U curve.

In 1994, Lopez provides a theoretical basis of the inverted U-shaped curve, and shows the relationship of any form of income and pollution; it is the Environmental Kuznets Curve (EKC), this relationship depends on the growth effect on the elasticity of substitution between factors of production and pollution. The CEK initially shows the environmental quality deteriorates with rising income.

From a certain level of wealth economic growth would be accompanied by an improvement in the state of the environment. That is to say that the company will adopt instruments for the environment.

Two phases up then this curve; the first is attributed to developing countries where the GDP per head has not yet reached a certain threshold.

In developed countries the situation is opposite: decreasing pollution by gross domestic product per head. This is the situation in Europe, the US and Japan, where technical effect outweighs the same time on the scale effect and the composition effect for several pollutants.

The criticism on the environmental Kuznets curve varies from one group of authors to another. Example Arrow et al (1996), there is only one link to the pollutants with short-term costs. According to these authors, the Kuznets curve is often checked for pollutant flows and not for stocks of pollutants.

In fact, this assumption does not take into account also the environmental absorption capacity. Yet the inclusion of this variable is important because a loss of strength thereof decreases biological productivity and its ability to support human life Davidson (2000).

Of this notice, Stern et al (1996) say that there are other problems when required to test this hypothesis. These authors found a unidirectional causality from economic growth to the quality of the environment.

[†] Source : Boutard.A, Brodhag.C, Gondran.N, lorsque le développement perd le Nord, page 28.

3. Methodology

3.1. Research Goal

In a world where the concept of sustainable development has become fundamental and where economic, social and ecological components are closely linked, it appears that studies the interrelationships between parameters integral part of these components, such as corruption, income and pollution, allow us to draw reliable conclusions lot of their relations and respective impacts on these components. These relationships lead to a distinction between two types of impacts; direct impact of corruption on pollution, and an indirect impact through the impact of corruption on per capita income. In this research, the methodology is to perform an econometric study using a panel all variables are related to the 1996-2013 period due to the availability of data for all countries in the sample and in particular for Iraq, Syria.

3.2. Sample and Data Collection

The data set is a balanced panel of 21 MENA countries and our empirical analysis covers the period from 1996 to 2013 for each country. The selected MENA countries included in the sample are Algeria(ALG),Bahrain(BHR), Egypt(EGY),Iran(IRN), Jordan(JOR), Morocco(MRC), Oman(OMN), Saudi Arabia (SAU), Syria(SYR), Yemen,Rep.(YEM),Sudan(SDN),Qatar(QAT),Mauritania(MRT),Libya(LBY),Lebanon(LBN),Iraq(IRQ),Ethiopia (ETH), United Arab Emirates(ARE), Kuwait(KWT), Djibouti(DJI) and Tunisia(TUN).These variables are obtained from World Bank Development Indicators(WDI).

The data on CO2 emissions were collected from Carbon World Development Indicators (WDI 2012). The data on gross domestic product (Y), exports(X),imports(M), trade, industry share in GDP(INdsh) and population density were taken from World Development Indicators (World Bank, 2013). Carbon dioxide emissions (E) are measured as metric tons of carbon per capita. Real GDP (Y) is GDP per capita in constant 2000 dollars. Trade is calculated as the sum of exports and imports of goods and services measured as the percentage of GDP. Population growth is measured in (annual %). Inflation (inf) These variables are the rate of inflation. (Appendix A).

3.3. Analyses and Results

In order to examine both the direct and indirect effects of corruption on pollution our methodology is based on the estimation of two equations, the first equation expresses pollution as a function of income, corruption and other variables (Zt).The second expressing income as a function of corruption and other factors.

Equations (1) and (2) are defined below:

$$lnE_{it} = \delta_t + \delta_c + \alpha_1 lnCORR_{it} + \alpha_2 lnY_{it} + \alpha_3 lnY_{it}^2 + \alpha_4 Z_{it} + \mu_{it} \quad (1)$$

$$lnY_{it} = \gamma_i + \tau_t + \beta_1 lnX_{it} + \beta_2 lnCORR_{it} + \varepsilon_{it} \quad (2)$$

Eq. (1) draws upon the environmental Kuznets curve literature, where E represents environmental degradation, i the specific pollutant that is used for the estimation, Y is income per capita, and Z are other explanatory variables that are supposed to influence pollution; These include the share of industry in GDP and the share of trade in GDP to investigate whether openness to trade influences emissions. t denotes a time index.and μit is the normally distributed error term .

Eq. (2) expresses per capita income as a function of corruption (CORR) and X, a vector of other explanatory variables that have commonly been used within the growth literature (Mankiw et al., 1992; Levine and Zervos, 1993).These variables include measures of the human capital and population growth and are added incrementally to assess the sensitivity of the coefficient on CORR to the inclusion of additional explanatory variables. γi and κt represent country and year specific effects, and εit denote error term.

The total effect of corruption on pollution decomposes into a direct and an indirect effect, the latter reflecting the impact of corruption on income and the impact of corruption on pollution. Formally, these effects can be expressed as follows:

$$\frac{dE}{dCORR} = \frac{\delta E}{\delta CORR} + \frac{\delta E}{\delta Y} \times \frac{\delta Y}{\delta CORR} \quad (3)$$

We propose an empirical methodology in 3steps.The first step consists to develop the long-run relationship between pollution, per capita income and corruption using the first equation Eq. (1). The second step consists to examine the relationship between per capita income and corruption using the second equation Eq. (2). Finally, the third step consists to estimate. The total effect of corruption on pollution decomposes into a direct and an indirect effect.

3.4. Results

In order to measure the direct impact of corruption on the gross domestic product per head, we start by estimating equation (2). At this level we notice that Eq. (2) suffers from potential endogeneity problems since income is a function of corruption, yet corruption is itself.

Initially, in order to test the overall significance of the model, we performed a preliminary estimate of the equation (2) Where as corruption as exogenous (first column of table1.).

Table1 the impact of corruption on per capita income

	Exogenous Corr FE	**Y(1) 2SLS**	**Y2 2SLS**	**Y3 2SLS**	**Y4 2SLS**
Corruption	-0.077***	-0.060***	-0.180***	-0.044***	-0.105**
	(0.037)	(0.015)	(0.045)	(0.016)	(0.043)
LFBCF	0.190***	0.00004***	0.00003***	0.00005***	0.00004***
	(0.026)	(6.50)	(6.51)	(7.68)	(8.14)
Lkh	0.101**	0.117**	0.139**	0.113**	0.176***
	(0.051)	(0.057)	(0.057)	(0.053)	(0.055)
Inf	0.002***		0.001	0.001*	0.001**
	(0.0008)		(0.009	(0.0008)	(0.0008)
Lcroi	-0.068**			-0.137 ***	-0.166***
	(0.030)			(0.047)	(0.040)
Ltrade	-0.420***				-0.146***
	(0.054)				(0.040)
constant	5.116***	7.911***	7.818***	7.947***	7.154***
	(0.334)	(0.246)	(0.233)	(0.227)	(0.478)
Observations	378	378	378	378	378
R-squared within	0.6087	0.4334	0.4679	0.5455	0.5936
R-squared between	0.9687	0.4719	0.6247	0.6333	0.8929
F (fisher)	72.56	544.92	596.81	636.30	150.72
	0.0000	0.0000	0.0000	0.0000	0.0000
Hausman test	31.29				76.44
prob>chi²	0.0000				0.0000
Test Wooldridge	9.4555				
Prob > F	0.0089				
Breusch-Pagan test	8.85				
Prob > Chi	0.0029				
sargan test		0.0000	0.0000	0.0000	0.0000
Prob > Chi²					
Anderson canon test		37.306	37.288	32.784	32.405
Prob > Chi²		0.0000	0.0000	0.0000	0.0000

Notes: 1. *, ** and *** are respectively the 1%, 5% and 10% of the significant level.

In all models corruption is found to be a negative and statistically significant determinant of income. Instrumenting CORR has the effect of increasing its coefficient in terms of both absolute value and statistical significance. The signs of the other explanatory variables are as expected, with the exception of population growth. Neither population growth or trade openness is found to be statistically significant but negatives. Finally, a Sargan test of overidentifying restrictions fails to reject the null that the instruments are uncorrelated with the error term and that the specification is correct. Similarly, F-tests indicate that the instruments used are jointly significant.

After having estimated equation (2) we will estimate equation (1), based on the model Y4 of equation (2), in order to clarify the impact of corruption on pollution via GDP per capita. Where Y4a the simplest theoretical model that verifies the traditional relationship of the environmental Kuznets curve

Table 2 provides our estimates of per capita pollution emissions, utilising the results of the 'full' income model (Y4)

Table2 Estimates of per capita pollution emissions based on model (Y4) in Table 1

	Y4a	Y4b
Corruption	0.051***	0.062**
	(0.024)	(0.025)
Pib	-0.536	-0.679*
	(0.113)	(0.139)
Pib2	0.033***	0.0.4***
	(0.007)	(0.009)
Pib3	-0.003***	-0.003***
	(0.000)	(0.000)
Lindsh		-0.036*
		(0.075)
Ltrade		0.185*
		(0.100)
constant	2.765	3.189
	(0.970)	(1.199)
Observations	378	378
R-squared		
R-squared within	0.187	0.2854
R-squared between	0.8744	0.8946
F (fisher)	144.00	110.72
	0.0000	0.0000
Hausman test	33.03	9.44
prob>chi^2	0.0000	0.0141
Test Wooldridge	20.927	19.492
Prob > F	0.0002	0.0003
Breusch-Pagan test	7.55	5.17
Prob > Chi	0.0060	0.0230

Notes: 1. *, ** and *** are respectively the 1%, 5% and 10% of the significant level.

In all four models CORR is found to possess a positive, statistically significant, relationship with per capita emissions. CO2 possess a statistically significant cubic relationship with per capita income. Finally, industry share (INDsh) is found to be a negative, but a non significant determinant of CO2, whilst trade openness (TRADE) is estimated to be a positive, significant determinant of CO2.

It is now possible to quantify the impact of corruption on pollution. Firstly, Table3 provides the direct, indirect and total effect of corruption on pollution for each of the four models presented in Table 2 (Y4a to Y4b) and also for the four models

The impact of corruption on pollution
(elasticities)

	$\frac{dE}{dCORR}$	$\frac{\delta E}{\delta Y} \times \frac{\delta Y}{\delta CORR}$	$\frac{\delta E}{\delta CORR}$
	Effet direct	Effet indirect	Effet total
CO_2			
Y4a	0.051	-0.063	-0.012
Y4b	0.062	-0.107	-0.045

The overall impact of corruption on emissions is estimated to be negative apart from at income levels towards the top of the sample income range. As can be seen, it is the shape of the indirect effects . The indirect effect stems from the product of δE/ δY and δY/ δCORR. From the models on which Figs. 1 and 2 are based (income model Y4 and emissions models Y4b and Y4d) δY/ δCORR=−0.122, whilst δE/ δY falls from 0.71 to 1.108 for CO2 throughout the sample income range. Thus, the indirect and total effects increase with income as a result of these positive but declining values of δE/ δY. These, in turn, stem from the fact that, throughout the sample income range, emissions of CO2 are increasing at a decreasing rate with per capita income(Appendix B).

4. Conclusion

The foregoing estimates shows that the effect of corruption on the gross domestic product per head is always negative and significant, which implies an increase in the level of corruption leads to lower living standards.
Our results are consistent with the idea that corruption and other institutional weaknesses affect the productivity of the country. They also affect the government's ability to control the quality of the environment.
Indeed, the results support the theoretical conclusion of Lopez and Mitra (2004) who argue that despite corruption, there is an inverted-U relationship between pollution and income.
The relationship between GDP per capita and the quality of the environment is difficult to conceptualize, it is certainly not always stable. This relationship is rarely monotonous: sometimes the economic growth of a country can be harmful to the environment, it becomes beneficial later.
This relationship is well defined in economic literature as part of the environmental Kuznets curve.
Foreign trade is not necessarily a good or bad for the environment. Its impacts depend on it, in fact, the extent to which the business objectives and environmental protection can be complementary and mutually reinforcing.

In conclusion, it is important to note that the results we have reached dependent variable in the model chosen and the study period. Other variables can be modeled on a well-defined period and that is the subject of another study in future.

Appendix

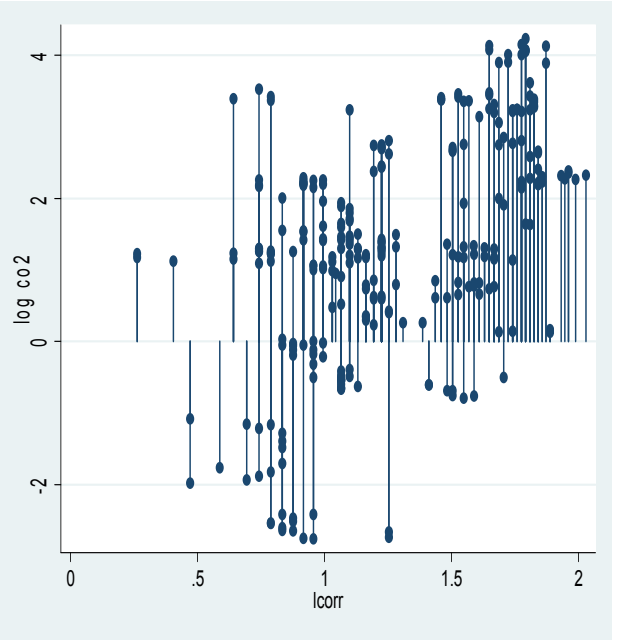
Appendix A

Summary statistics

Variable	Obs	Moyenne	Ecart type (σ)	Minimum	Maximum
PIB	378	6772.769	8592.455	118.0994	38960.11
Inflation	284	78.417	10.884	-21.632	67.171
Croissance	286	2.496	1.505	0.590	12.827
CO_2	286	9.806	13.820	0.063	68.626
Corruption	276	3.797	1.474	1.3	7.6
X	266	41.510	20.409	5.343	99.531
M	266	39.927	17.631	12.514	95.705
KHumain	112	64.125	26.976	11.762	98.737
FBCFsh	258	21.302	6.835	-23.762	46.379
FBCF	262	1544.298	2336.611	-102.8189	15261.9
INDsh	283	36.201	15.662	10	81
Trade	265	0.057	0.077	0.002	0.338

Appendix B

Fig1. CO2 emissions and corruption (21 countries, 1996–2013).



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